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Report of the
COMSTAC Technology & Innovation Working Group

**COMMERCIAL SPACE LAUNCH SYSTEM
REQUIREMENTS**

25 July 1996



Paul N. Fuller, Chairman
Technology & Innovation
Working Group

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Office of the Associate Administrator for Commercial Space Transportation
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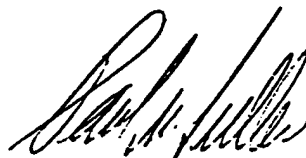
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I. INTRODUCTION

This report presents recommended requirements of the commercial spacecraft and space launch industries for the next generation of space launch systems. It was prepared by the Commercial Space Transportation Advisory Committee (COMSTAC), which advises the Secretary of Transportation on commercial space industry issues. This report supersedes the "*Commercial Space Launch System Requirements*", dated 5 April 1993 (reference 1).

The COMSTAC has consistently urged that commercial requirements for launch services be included in the design basis of the next launch system developed by the US Government for access to space for its security and civil science payloads. The COMSTAC believes that developing the next generation launch systems based on requirements which include those of the commercial satellite industry ensures a substantial commercial user base that would result in the cost of government launch services being substantially less than if the launch systems were optimized for Government payloads only. The COMSTAC also believes that it is in the best interest of the spacecraft manufacturers to have a healthy, competitive US launch vehicle fleet to draw upon.

This report is intended to be used as a source of the commercial space launch industry requirements for future launch systems, including the proposed Evolved Expendable Launch Vehicle (EELV) and the proposed Reusable Launch Vehicle (RLV).

II. DISCUSSION

This report presents the results of COMSTAC's Technology and Innovation Working Group to define the commercial requirements for future space launch systems.

The approach taken was to:

- Identify the key requirements that today's commercial satellite supplier/customer considers in selecting a specific launch service from the many offerings. The use of the term "launch service" rather than launch vehicle is deliberate and reflects the realization that satellite customers are purchasing transportation services not hardware.
- Identify the capabilities, changes or enhancements in the key requirements that would provide a distinct advantage for new US launch vehicles to compete in the international markets in the early 21st century.

The commercial spacecraft industry's fundamental requirements are: (1) availability, (2) price (including insurance), (3) reliability, (4) cycle time (order to launch), and (5) performance consistent with commercial needs listed later in the report.

Payload Capability

The trend for launch vehicle payload, i.e. spacecraft, mass and size to grow may continue. Specific payload trends and distributions by launch vehicle category can be found in the COMSTAC report "*Commercial Spacecraft Mission Model Update*" (reference 2). On the other hand, the adoption of electric propulsion by spacecraft manufacturers has the potential of arresting spacecraft growth in the near term. Future US commercial launch systems should provide a payload capability of 11,000 lb to geosynchronous transfer orbit (GTO) with a 4-meter fairing (≥ 3650 mm payload static envelope), to provide equivalent or superior capability to that of current foreign launchers. The systems should have pre-planned growth capability up to 15,000 lb to GTO and a 5-meter fairing (≥ 4570 mm payload static

envelope) to compete with planned foreign launchers. Future US launch systems should match or exceed the performance of foreign systems including effects of their near-equatorial launch sites.

System Level Requirements

System-level requirements for future commercial launchers were established by the Working Group in the areas of price, payload capability, reliability and responsiveness. The list of commercial requirements is the minimum set considered "mandatory" for success in the international commercial launch services market in the early 21st century. Quantified commercial requirements for future Expendable Launch Vehicle (ELV) and Reusable Launch Vehicle (RLV) systems are presented in Table 1. Data are listed separately for the ELV (both near-term and growth cases) and for the RLV.

Specific requirements are provided in the table for : 1) launch service price (\$/lb to GTO), 2) payload capability (lb mass to GTO), 3) mission success reliability, and 4) launch on schedule responsiveness. Other requirements include the ability to increase payload weight and size, the ability to multiple manifest payloads, and responsiveness criteria.

Currently, commercial user requirements for launch services do not distinguish between expendable and reusable vehicles. The major difference in launch vehicle requirements is turn around time which affects reuse rate and the recurring launch service price. Therefore, the commercial requirements for an advanced Growth version of ELV systems and the RLV system are similar.

Table 1. Commercial Launch System Near Term Requirements and Long Term Goals

Requirements	ELV		RLV
	Near Term (1998-2000)	Growth	
Price/lb to GTO	≤ \$6,000	≤ \$4,000	≤ \$1,000
Capability			
• Payload Weight GTO*	3,000 to 11,000 Lbs	15,000 lbs	15,000 lbs
• Fairing Size	4 meter	5 meter	5 meter
• Multiple Manifest	Option	Option	Option
• Adapters	Current Heritage	As Required	As Required
Reliability	≥ 98%	≥ 99%	≥ 99%
Responsiveness			
• Launch Schedule	90% within 10 days of schedule	95% within 10 days of schedule	95% within 5 days of schedule
• Re-Flight	12 months	12 months	12 months
• Order-to-Launch	18 months	12 months	12 months
• S/C Time on Pad	< 1 week	< 5 days	< 2 days

* At 0-degree inclination

The launch rate for the U.S launch systems must be sufficient to accommodate anticipated demand. The total addressable worldwide GEO commercial market demand, excluding US Government and commercial LEO spacecraft, is approximately 31 per year as presented in the 1996 COMSTAC "Commercial Spacecraft Mission Model Update" (reference 2).

The period of time the vehicle is on the launch pad should be minimized to reduce cost, and the designs should be sufficiently robust to provide a high probability of executing a successful launch on schedule.

The time to recover (return to flight) following a launch failure is also a key commercial consideration in launch service selection.

To respond to the requirement to minimize program cost, future launch systems should also be operationally efficient with short cycle times required for payload integration, payload substitution, and system maintenance. The total lead time for mission integration and launch should be no longer than 12 months. The system should be compatible with personnel services and facilities available at existing government launch sites and ranges.

Of course, all future launch systems must be designed and operated to preclude endangering human life and in consideration of public safety.

Market Considerations

Table 2 lists other commercial space launch systems considerations in the areas of Flight Design, Operations, Programmatics, and Launch Environment.

The most important requirement is a low recurring price (e.g. a US based rocket with the same GTO capability to a 27° inclination as foreign launch vehicles at equatorial launch sites and selling for the same price is not competitive). The ability to launch on schedule is also a very important system requirement, because of the financial impact of time delays in the commercial launch business. Launch delays, for whatever reason, increase launch costs, and delays the revenue stream expected from the on-orbit payload.

System-level requirements such as payload growth capability, the option for multiple manifesting, payload fairing size, and system robustness/resiliency are also very desirable characteristics and will enhance the competitiveness of the future commercial system.

III. CONCLUSIONS AND RECOMMENDATION

Requirements for commercial space launch systems are constantly evolving in response to market conditions. Of all the system-level requirements identified, those critical to competitiveness of the future commercial launch system continue to be (no order of priority):

- Price including insurance
- Availability
- Mission success reliability
- Ability to launch on schedule
- Payload launch capability

The requirements contained in this report represent a "snapshot" of the competitive commercial space launch industry in 1996. The COMSTAC technology and Innovation Working Group will continue to assess evolving commercial space launch requirements an issue updated reports, as required.

The COMSTAC recommends that this 1996 Commercial Space Launch System Requirements Report be provided to the appropriate US Government agencies for their use.

Table 2. Other Commercial Space Launch Systems Considerations

Flight Design	Provide for LEO, MEO, GTO and GEO capability
Operations	Minimize government oversight of spacecraft processing, e.g., procedures approved, presence during operations, etc. by providing certification of commercial contractors operations. Current approach at CCAS increases commercial spacecraft contractor's costs.
	Modernize CCAS and Vandenberg range infrastructure. Downtime and range re-configuration time between launches reduces launch frequency which reduces available market.
	Provide cost effective spacecraft pre-launch processing services
Programmatic	Formulate and publish a firm policy for launch manifesting and range support which should include no bumping except in a Presidentally decreed National emergency. All users need to be, and believe that they will be, treated equally with respect to space launch services. Obtaining government and commercial industry buy-in of policy is necessary.
	Continue government policy to provide launch vehicle contractors with fixed price services. This allows launch services providers to price their services competitively. Uncertainty in the cost for range support and other government provided services would force launch services providers to bias their prices upward
	Allow future launch services providers to operate commercially at government launch facilities. The current model used by MDA and Lockheed Martin for supporting commercial launches at CCAS is excellent but can be improved.
Launch Environments	Match or improve, i.e., reduce, current flight environments especially acoustics
	For new launch systems, provide instrumentation to verify flight environments

IV. ACRONYMS

CCAS	Cape Canaveral Air Station (Eastern Range)
COMSTAC	Commercial Space Transportation Advisory Committee
ELV	Expendable Launch Vehicle
EELV	Evolved Expendable Launch Vehicle
GEO	Geosynchronous Earth Orbit
GTO	Geosynchronous Earth Orbit Transfer Orbit
LEO	Low Earth Orbit
LM	Lockheed Martin
MDA	McDonnell Douglas Aerospace
MEO	Medium Earth Orbit
RLV	Reusable Launch Vehicle

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